USGS

Sound Waves Coastal and Marine Research News from Across the USGS

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Fieldwork

USGS Arctic Ocean Research: A Polar Ocean Acidification Study

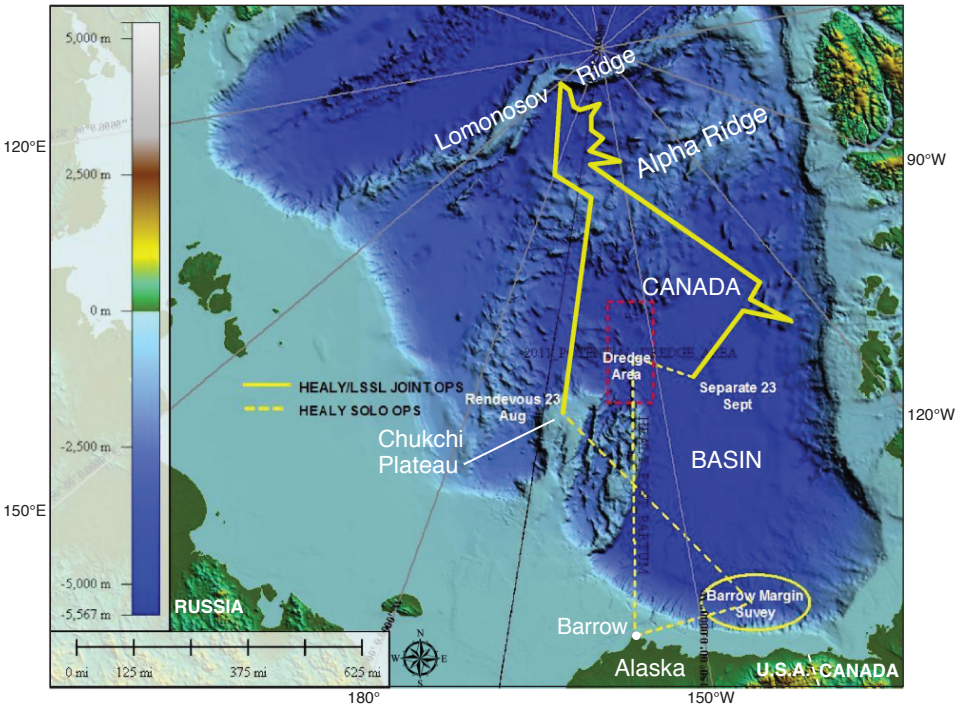
By Lisa L. Robbins

Scientists from the U.S. Geological Survey (USGS) and the University of South Florida (USF) are working on an icebreaker in the Arctic Ocean during August and September 2011, continuing studies begun last year on Arctic Ocean acidification. Their findings will provide an important baseline of information about Arctic Ocean chemistry, which is likely to change in response to projected declines in summer sea ice. Follow their progress at **http://coastal.er.usgs.gov/ocean-acidification/arcticcruise2011/**.

Ocean acidification is the result of elevated atmospheric CO_2 that has been mixed with oceanic surface water, resulting in lower (more acidic) oceanic pH. The lower pH, and a concomitant decrease in carbonate in the ocean, can lead to problems for biota such as calcifying phytoplankton and shellfish and, in turn, can affect the oceanic food chain. One of the most vulnerable and little known areas for ocean acidification on our planet is the Arctic Ocean.

USGS scientists from the St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida, and their colleagues from USF in Tampa departed on August 15 from Barrow, Alaska, on the U.S. Coast Guard Cutter *Healy* for a 7-week expedition to the western Canada Basin and the northern Arctic Ocean. They are working side-by-side with other scientists on the *Healy* who are gathering data for the Extended Continental Shelf Project, a multiagency program to determine the extent of the United States' "extended continental shelf," where the nation can exercise sovereign rights over resources on and beneath the seabed according to the provisions of the Convention on the Law of the Sea (learn more at **http://www.continentalshelf.gov/**).

(Arctic Ocean Acidification continued on page 2)



Arctic Ocean seafloor, showing planned track-line for the 2011 cruise, scheduled to run from August 15 to September 28. Seafloor depths are color-coded, from bluish green (shallow) to dark blue (deep). Color key at left shows elevations in meters. LSSL, Louis S. St-Laurent, *the Canadian Coast Guard Ship that will accompany the* Healy *during joint "ops" (operations). Learn more about the joint U.S.-Canadian cruises at* ***http://continentalshelf.gov/****.*

The U.S. Coast Guard Cutter Healy *(foreground) and the Canadian Coast Guard Ship* Louis S. St-Laurent. *The two icebreakers take turns breaking ice for each other as they collect bathymetric data (*Healy*) and seismic-reflection data (*Louis*) during joint operations in the Arctic. The ocean-acidifcation team is on the* Healy.

Sound Waves

Editor
Helen Gibbons
Menlo Park, California
Telephone: (650) 329-5042
E-mail: hgibbons@usgs.gov
Fax: (650) 329-5190

Print Layout Editors
Susan Mayfield, Sara Boore
Menlo Park, California
Telephone: (650) 329-5066
E-mail: smayfiel@usgs.gov; sboore@yahoo.com
Fax: (650) 329-5051

Web Layout Editor
Jolene Gittens
St. Petersburg, Florida
Telephone: (727) 803-8747 Ext. 3038
E-mail: jgittens@usgs.gov
Fax: (727) 803-2032

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Deadline: The deadline for news items and publication lists for the October issue of *Sound Waves* is Thursday, August 25.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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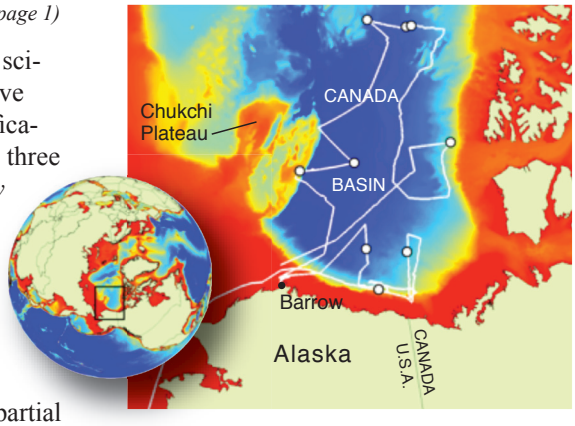
Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

Want to e-mail your question to the USGS? Send it to this address: ask@usgs.gov

Fieldwork, continued

(Arctic Ocean Acidification continued from page 1)

This is the second year in which scientists from the USGS and USF have conducted research on ocean acidification in the Arctic. In summer 2010, three geochemists were aboard the *Healy* in the Arctic Ocean for 5 weeks. During that cruise, water samples were collected continuously every 2 minutes by the Multiparameter Inorganic Carbon Analyzer (MICA), resulting in a remarkable +25,000 records of data on pCO_2 (partial pressure of CO_2), pH, and total dissolved inorganic carbon along ship's paths totaling more than 9,450 km. Such an extensive high-resolution dataset had never before been collected in the Arctic Ocean. Discrete water samples were taken every 2 hours throughout the cruise and analyzed onboard for pH, alkalinity, and carbonate (CO_3^{-2}). An additional 240 discrete samples were collected and subsequently analyzed in laboratories on land for carbon and oxygen isotopes, nutrients, and metals. Ten vertical casts (during which a sampling instrument is lowered from the ship to near the seafloor) using a rosette sampler were also performed, allowing collection of water from as deep as 3,500 m. This sampling device—a frame holding a circle, or rosette, of water-sampling bottles triggered remotely from the ship—collects water at prescribed depths throughout the water column. (Read more about water sampling during the 2010 Arctic expedition at **http://continentalshelf.gov/missions/10arctic/logs/aug25/aug25.html**.)



Trackline of August/September 2010 cruise. Circles show locations of "vertical casts," where samples were collected throughout the water column by a rosette sampler lowered from the ship to near the seafloor.

Data from the 2010 cruise in the Arctic Ocean are being processed for quality assurance and analyzed for trends and will be published in the USGS Data Series. Preliminary data were presented at poster sessions at the Alaska Marine Science Symposium in Anchorage on January 18 and at the American Society of Limnology and Oceanography (ASLO) Aquatic Sciences Meeting in Puerto Rico on February 15, 2011. The presentations met with enthusi-

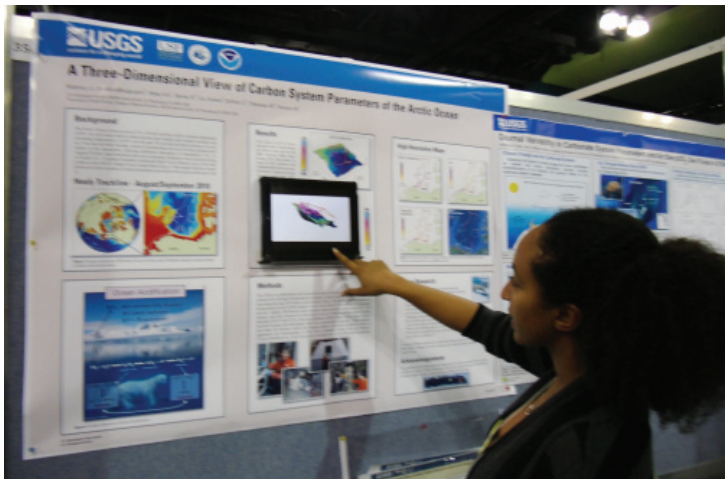
(Arctic Ocean Acidification continued on page 3)

The Multiparameter Inorganic Carbon Analyzer (MICA) is a flow-through system that analyzes water samples every 2 minutes for pH, pCO_2, and total dissolved inorganic carbon.

(Arctic Ocean Acidification continued from page 2)

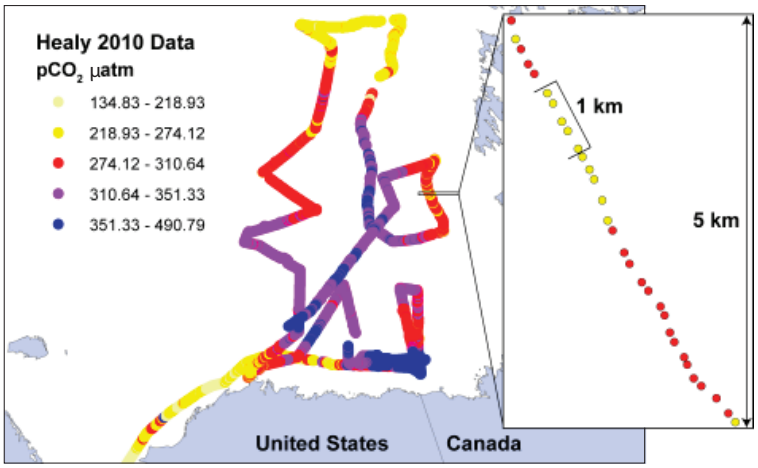
astic responses as 3-D views of the Canada Basin carbon parameters were shown on an iPad mounted to the posters, enabling symposium participants to interact with the data. In particular, the data show the quality and high-resolution spatial information that this unique dataset provides. A synoptic view of the plotted data shows a continuous line more than 9,400 km long; zooming into an area reveals data points that were taken every 2 minutes and, consequently, the details of specific areas. These data show the overall trends and comprehensive structure of the carbon chemistry of seawater in the Canada Basin and, significantly, can be used for modeling the carbonate saturation state of this part of the Arctic Ocean. (Carbonate saturation state is a measure of the potential for a solution—such as seawater—to precipitate or dissolve calcium carbonate. The greater the saturation state, the more the precipitation of calcium carbonate is favored, and the easier it is for calcifying organisms to build their shells and skeletons.)

In August and September 2011, USGS senior scientist **Lisa Robbins**, **Chris DuFore** (USGS), **Brian Buczkowski** (USGS), **Paul Knorr** (USGS), and **Jonathan Wynn** (USF-Geology) will be on the *Healy*, while **Kim Yates** (USGS), **John Lisle** (USGS), and **Bob Byrne** (USF-Marine Science) remain on land. The onboard Arctic team is using the same data-collection techniques as in 2010: running the MICA continuously to collect and analyze seawater every 2 minutes, collecting discrete water samples every 2 hours from the *Healy's* flow-through seawater system for onboard analysis, and using a rosette sampler to collect samples throughout the water column when the ship is stopped "on station." This summer, the *Healy* added a new pCO_2 analyzer that is built into the flow-through sampling system, and the ocean-acidification team added an AFT (autonomous flow-thru) system (Sunburst, LLC) that also monitors pCO_2. Because the 7-week cruise does not include scheduled "port calls" where broken parts could be fixed, the scientists are using these robust and redundant data streams as insurance against any system failing, with the added benefit of enabling inter-calibration and comparison of techniques. Using this sampling strategy, the scientists aboard the *Healy* are obtaining carbonate parameters, as well as pH, dissolved oxygen, fluorescence, salinity, temperature, and depth information, to gain a better understanding of the regional ocean chemistry in this rapidly changing environment. Equally important, a team back at the USGS center in St. Petersburg is working with the onboard team to monitor and analyze the Arctic data feeds and to analyze samples collected on the *Healy* when the scientists return from the field. This year, the ship is expected to reach more northerly latitudes than last year, which will provide the opportunity to collect data inside and outside of the Canada Basin—potentially as far north as the Lomonosov Ridge.



Participant in the 2011 American Society of Limnology and Oceanography meeting in Puerto Rico uses a touch-screen to explore an interactive 3-D model of carbon system parameters in the Arctic Ocean.

For the first time, the ocean-acidification research-cruise team has an educational outreach blog on the USGS St. Petersburg Web site and is also posting information on Twitter and Facebook. Many local public and private elementary, high-school, and college students are following the cruise information feeds from home as well as from the classroom, allowing students and teachers a unique educational opportunity to see day-by-day how scientists live on a research vessel and collect samples and data in the field. Scientists at sea and at the USGS center are providing the information to the students by posting pictures and blog entries sent from the field. Student visits to the USGS office are planned for later in the year as an additional "meet the scientists" educational opportunity. Scientists, students, and the general public can track the ocean-acidification research on the 2011 Arctic cruise at **http://coastal.er.usgs.gov/ocean-acidification/arcticcruise2011/**.



Trends in values of pCO_2 (partial pressure of CO_2) in seawater from data collected in 2010. µatm, micro atmospheres.

Three-Week Expedition Images Sediments Beneath the Gulf of Alaska

By Helen Gibbons, Ginger Barth, Debbie Hutchinson, and Jonathan Childs

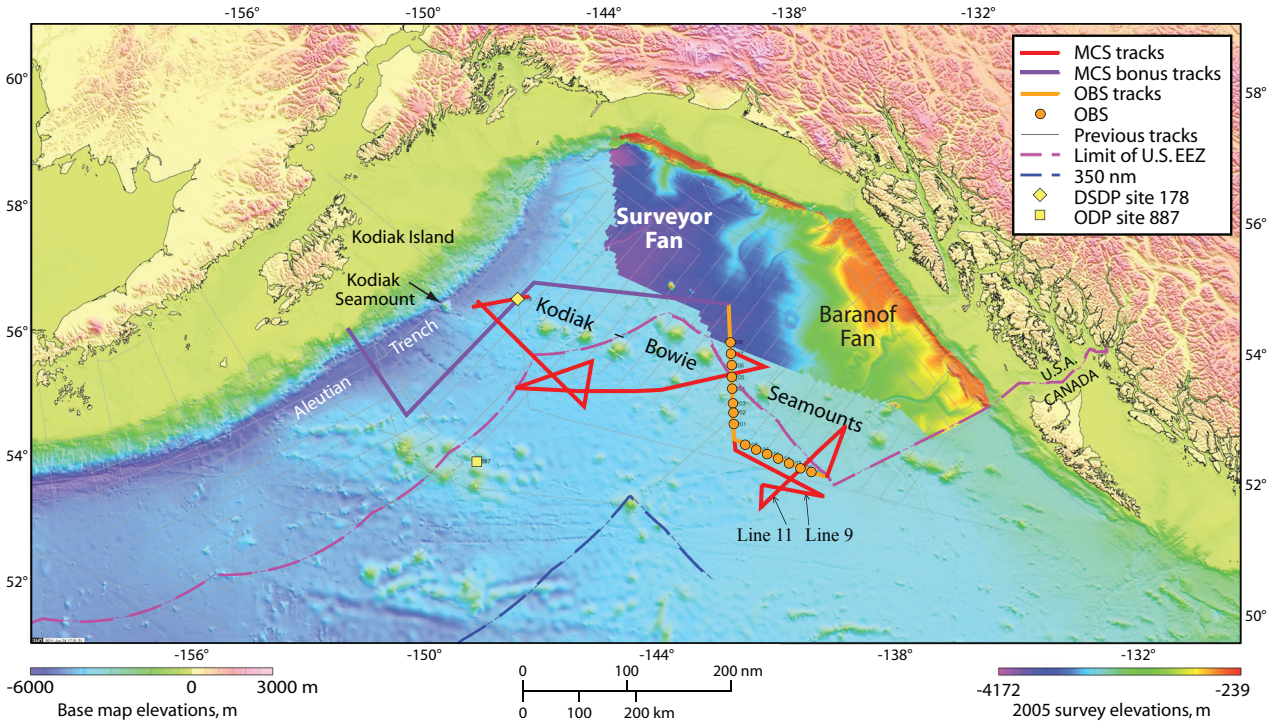
In June 2011, scientists aboard the research vessel *Marcus G. Langseth* acquired detailed images of sediment layers and volcanic bedrock beneath the Gulf of Alaska. This research cruise was the first opportunity for the U.S. Geological Survey (USGS) to conduct scientific investigations of the central Gulf of Alaska in more than 20 years, since the GLORIA mapping program in 1989.

Research vessel Marcus G. Langseth. *Photograph courtesy of Lamont-Doherty Earth Observatory* ***(http://www.ldeo.columbia.edu/res/fac/omo/images/langseth_web.jpg)***.

The primary objective was to determine the thickness of sediment along the outer parts of the Surveyor and Baranof submarine fans—delta-like piles of sediment deposited by underwater avalanches called turbidites. The scientists sought to determine whether the outer fans have sufficient sediment thickness to satisfy the criteria for U.S. "extended continental shelf"—where the nation can exercise sovereign rights over resources on and beneath the seabed according to the international Convention on the Law of the Sea. (For more information, see **http://continentalshelf.gov/**.)

Additional objectives were to improve understanding of the geology of this remote and little-imaged part of the ocean, to explore the processes and structures that control the distribution and movement of seafloor sediment in this region, to understand the interaction between sediment pathways and basement topography (the shape of the bedrock surface buried beneath the sediment), and to help refine the history of climatic and tectonic influences on the development of these deep-water

(Gulf of Alaska continued on page 5)



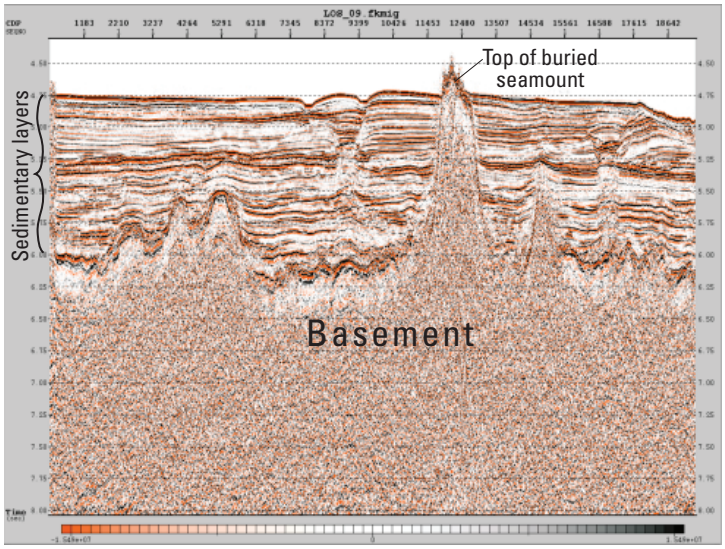
Gulf of Alaska seafloor, showing June 2011 cruise tracks and ocean-bottom seismometer (OBS) locations. Data were collected along primary multichannel seismic (MCS) reflection lines (red) to measure sediment thickness in support of delimiting U.S. extended continental shelf according to the Convention on the Law of the Sea; OBS refraction lines (orange) were placed to establish speed of sound in sediment layers of the Baranof fan system; additional MCS reflection lines (purple) were run during extra time available at the end of the cruise. nm, nautical mile; EEZ, Exclusive Economic Zone (extends approximately 200 nm from shore or to a maritime boundary with another nation); 350 nm, the limit beyond which a nation's extended continental shelf may not extend; DSDP, Deep Sea Drilling Program; ODP, Ocean Drilling Program. Bathymetric data in northeast part of gulf were acquired in 2005 by the University of New Hampshire's Center for Coastal and Ocean Mapping/Joint Hydrographic Center (see ***http://ccom.unh.edu/index.php?p=51\|56\|60\|60&page=unclos/alaska.php****).*

(Gulf of Alaska continued from page 4)

sediment fans. Preliminary observations indicate that ridges, valleys, and other elements of the bedrock surface long buried beneath the sediment continue to control the locations of channels and other features on the seafloor.

Leading the cruise were chief scientist **Ginger Barth**, a USGS geophysicist, and co-chief scientist **Sean Gulick**, a research scientist from the Institute for Geophysics (UTIG) in the Jackson School of Geosciences, University of Texas at Austin. Also onboard for this science mission were USGS geophysicists **Jonathan Childs**, **Patrick Hart**, and **Ray Sliter**; USGS sound-source mechanic **Jenny White**; UTIG geophysicists **Bobby Reece**, **Ryan Lester**, **Maureen LeVoir**, and **Kevin Johnson**; and University of Wyoming geophysicist **Erik Everson**. Aboard the support vessel *Norseman II*, USGS scientists **George Tate**, **Dennis Mann**, and **Diane Minasian**, along with Woods Hole Oceanographic Institution seismic-instrument technicians **David DuBois** and **Timothy Kane**, completed the science party.

A multichannel seismic-reflection system, commonly abbreviated as a "multichannel seismic" or "MCS" system, was the main tool used to collect data during the cruise. Similar to an echosounder, a seismic-reflection system makes use of sound energy, which travels easily through water and rock and reflects off boundaries between materials with differing acoustic properties. Examples are the boundary between water and sediment (the seafloor), the boundaries between sediment layers of different materials (for example, sand versus mud), and the boundary between sediment and hard volcanic rock (the geologic "basement"). Seismic-reflection systems use sound energy at frequencies that enable the sound to penetrate deep (as much as several kilometers) beneath the seafloor and bounce off boundaries between subseafloor layers. The resulting "profile" is a cross-sectional view of the geologic layers beneath the seafloor, similar to what you might see in a canyon wall. The MCS data-acquisition system towed behind the *Langseth* during the June 2011 cruise consisted of an array of 36 pneumatic sound sources, or "air guns," to generate the sound energy and an 8-km-long streamer containing 636 groups, or "channels," of hydrophones (underwater microphones) to receive the echoes.



Preliminary migrated seismic-reflection image of MCS Line 9 from the June 2011 Langseth *cruise, showing some of the thickest sediment observed anywhere in the Gulf of Alaska, located beyond 200 nm from the Alaska baseline in the Baranof channel and fan system. The sedimentary layers shown here are more than 1.5 km thick.*

During the cruise, the scientists collected 3,321 km of seismic-reflection profiles along the ship's track. Fortuitously, the hydrophones also recorded seismic waves from a magnitude 7.2 earthquake that struck the Fox Islands in Alaska's Aleutian Island chain on June 24, 2011. In addition to seismic-reflection data, the scientists collected approximately 3,800 km of trackline gravity and magnetic data, multibeam bathymetric data, and chirp subbottom profiles. Like MCS reflection profiles, chirp subbottom profiles are cross-sectional views of sedimentary layers. Produced by higher-frequency sound energy, chirp subbottom profiles provide greater detail than MCS reflection profiles but do not extend nearly as deep beneath the seafloor.

To correctly interpret seismic-reflection data, scientists need to know the speed of sound in the sub-seafloor layers, which varies with such factors as porosity, grain

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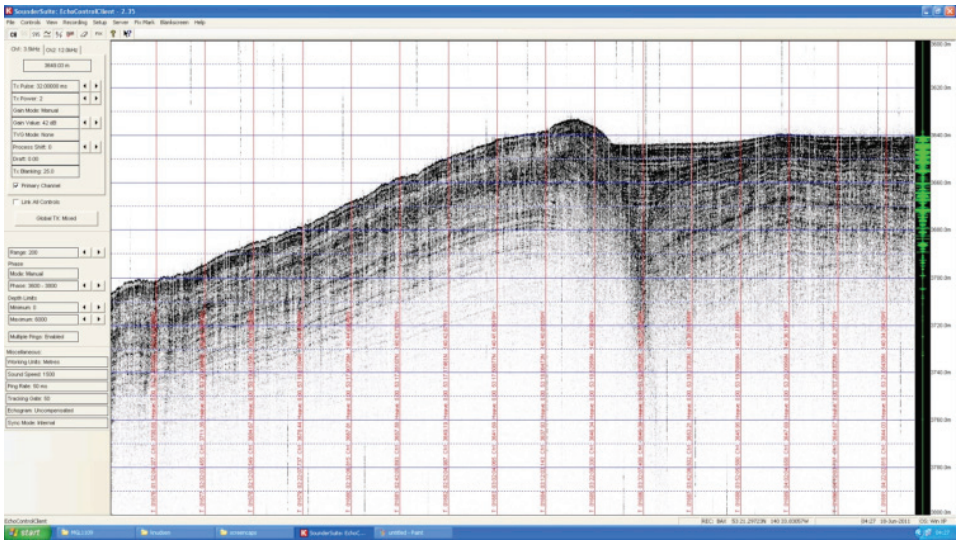

Chirp 3.5-kHz subbottom profile from the June 2011 Langseth *cruise, showing more than 60 m of sound-signal penetration in the vicinity of the southwest edge of the Baranof fan system. Profile shows a modern channel and levee running along the very edge of the vast Baranof system. Aggradational fan channels, such as this one, appear to build the margin upward and outward over time. Profile is located at the south end of MCS line 11.*

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size, and rock type. Variation in the speed of sound causes sound waves to bend, or "refract," as they move through different layers. Ocean-bottom seismometers (OBS) helped the scientists pick up refracted sound energy. (Learn more about ocean-bottom seismometers at **http://woodshole.er.usgs.gov/operations/obs/whatobs.html**.) Thirteen days into the cruise, the research vessel *Norseman II* rendezvoused with *Langseth* and deployed 15 ocean-bottom seismometers along two lines, each approximately 200 km long. Data recorded by the ocean-bottom seismometers will be used to calculate the speed of sound in the sub-seafloor layers, which will allow the scientists to calibrate their interpretations of the seismic-reflection images and to develop hypotheses about the nature of the sediment in the various layers and the underlying volcanic rocks of the oceanic crust.

The June cruise yielded a valuable dataset that will allow scientists to reconstruct many aspects of sediment routing and climate and tectonic history in the Gulf of Alaska region. Two major scientific results already evident from this study involve the significance of basement topography—the shape of the bedrock beneath the sediment layers. First, the Kodiak-Bowie seamount province is considerably broader and more voluminous than is evident from a bathymetric map. Sediments are surprisingly thin landward of the Kodiak-Bowies, as the basement itself is shallower than expected, and many significant seamounts (with original elevations greater than 1 km) are buried just beneath the sediment surface. Second, sediment routing throughout the vast Gulf of Alaska appears to be profoundly shaped by basement structure, even long after the primary basement topography has been completely buried. This relation holds true for features of the Surveyor and Baranof fans on a regional scale and over the course of many millions of years, as evidenced by stacked channel systems whose placement was originally controlled by fracture-zone ridges and troughs and by irregular barriers within now-buried groups of seamounts.

The data will also support further development of an Integrated Ocean Drilling Program (IODP) proposal to drill a research hole in the Gulf of Alaska, add to a growing number of seismic oceanography datasets, and contribute to the understanding of earthquake and tsunami processes on the Alaska margin. ❁

U.S. West Coast Erosion Spiked In Winter 2009-10, Previewing Likely Future As Climate Changes

By Patrick Barnard and Paul Laustsen

Knowing that the U.S. west coast was battered during the winter of 2009-10 by a climatic pattern expected more often in the future, scientists have now pieced together a San Diego-to-Seattle assessment of the damage wrought by that winter's extreme waves and higher-than-usual water levels. Developing a better understanding of how the 2009-10 conditions tore away and reshaped shorelines will help coastal experts better predict future changes that may be in store for the Pacific coast, the researchers say.

"The stormy conditions of the 2009-10 El Niño winter eroded the beaches to often unprecedented levels at sites throughout California and vulnerable sites in the Pacific Northwest," said **Patrick Barnard**, U.S. Geological Survey (USGS) coastal geologist. In California, for example, winter wave energy was 20 percent above average for the years dating back to 1997, resulting in shoreline erosion that exceeded the average by 36 percent.

Among the most severe erosion was at Ocean Beach in San Francisco, where the winter shoreline retreated 184 ft, 75 percent more than in a typical winter. The erosion resulted in the collapse of

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*Storm erosion of coastal bluffs at Ocean Beach, San Francisco, California, in early 2010. Photographs by **Jeff Hansen**, USGS.*

(West Coast Erosion continued from page 6)

one lane of a major roadway and led to a $5-million emergency remediation project. In the Pacific Northwest, the regional impacts were moderate, but the southerly shift in storm tracks, typical of El Niño winters, resulted in severe local wave impacts to the areas north of headlands, jetties, and tidal inlets. For example, north of the entrance to Willapa Bay along the Washington coast, 345 ft of shoreline erosion during the winter of 2009-10 destroyed a road.

The beach erosion observed throughout the U.S. west coast during the 2009-10 El Niño is linked to the El Niño Modoki ("pseudo" El Niño) phenomenon, in which the warmer sea-surface temperature is focused in the central equatorial Pacific (as opposed to the eastern Pacific during a classic El Niño). As a result of these conditions, the winter of 2009-10 was characterized by above-average wave energy and ocean-water levels along much of the west coast, conditions not seen since the previous major El Niño (classic) in 1997-98. The higher wave energies and water levels contributed to the observed patterns of beach and inlet erosion.

As even warmer waters in the central Pacific are expected in the coming decades under many climate-change scenarios, El Niño Modoki is projected to become a more dominant climate signal. When combined with still higher sea levels expected due to global warming, and potentially even stronger winter storms, these factors will likely contribute to increased rates of beach and bluff erosion along much of the U.S. west coast, producing regional, large-scale coastal changes.

The study, "The impact of the 2009-10 El Niño Modoki on U.S. West Coast beaches"—published in the American Geophysical Union's *Geophysical Research Letters* on July 9, 2011 (**http://dx.doi.org/10.1029/2011GL047707**)—was led by the USGS in collaboration with the Oregon Department of Geology and Mineral Industries, the University of California-Santa Cruz, the Washington Department of Ecology, Oregon State University, and Scripps Institution of Oceanography. The authors took advantage of as much as 13 years of seasonal beach-survey data along 148 miles of coastline and tracked shoreline changes through a range of wave conditions.

USGS is Valuable Partner in First St. Petersburg, Florida, Science Festival

By Heather A. Schreppel

On April 30, 2011, more than 5,500 visitors of all ages turned out to enjoy the inaugural St. Petersburg Science Festival, an event that explored the world of science while inspiring and informing the public about the role that science plays in society. The festival was held in conjunction with MarineQuest, the annual open house of the Florida Fish and Wildlife Commission's Fish and Wildlife Research Institute, and provided a venue where children and adults could enjoy more than two dozen hands-on activities from various science-related organizations and businesses.

Future scientists put a little muscle into crushing seashells simulating those grown in seawater with a lower pH while learning the effect that acidic conditions can have on marine calcifiers, organisms that grow their shells or skeletons from calcium carbonate.

In recent years, large, inspiring celebrations of the fascinating world of science and technology have been popping up across the nation. These science festivals provide new opportunities for scientists and engineers to reach out to the public and showcase what they do, hoping to re-invigorate the declining interest of our Nation's youth and public in science, technology, engineering, and math.

St. Petersburg, Florida, is a natural choice to host such a festival. The city's proximity to Tampa Bay and the Gulf of Mexico makes it a prime spot for marine science, and it is home to a world-class marine-science research community—the largest in the southeastern United States. Located along the waterfront in downtown St. Petersburg, the Marine Science Complex includes multiple federal, state, and local agencies, as well as nonprofit organizations (see related article in *Sound Waves*, June 2008, at **http://soundwaves.usgs.gov/2008/06/staff5.html**). This shared complex is conducive to creating multidisciplinary teams of scientists who combine their areas of expertise to focus on issues affecting Florida, the nation, and the world. Several years ago, the leaders of this community began brainstorming the idea of hosting a science festival.

***Theresa Burress** demonstrates the properties of CO_2 to a curious family enjoying their day at the festival.*

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The U.S. Geological Survey's (USGS) St. Petersburg Coastal and Marine Science Center has been an important partner in the planning and coordination of this festival from the start. Center Director **Jack Kindinger** and information specialist **Ann Tihansky** collaborated with **Bill Hogarth** (former dean of the University of South Florida College of Marine Science [USF-CMS]), **Paula Coble** (USF-CMS), and **Howard Rutherford** (The Pier Aquarium) to come up with the initial concept. They continued participating on the steering committee for several years leading up to the inaugural festival. **Heather Schreppel** and **Theresa Burress** of the USGS St. Petersburg center were involved in planning the first inaugural event, participating this past spring on multiple committees. Additionally, **Schreppel** designed the festival's Web site, **http://www.stpetescifest.org/**.

The inaugural event kicked off on the University of South Florida St. Petersburg's Bayboro Harbor campus with a rousing performance by the Progressive Baptist Missionary Community Church Drumline and Color Guard. City Councilman **Karl Nurse** spoke about the value of science, technology, engineering, and math as career choices for adolescents, economic engines for the community and the nation, and reliable resources to help both individuals and civic leaders make informed decisions. This event truly met its goal of being an engaging, informative occasion for families and the general public to explore the wonders of science, technology, engineering, and math.

*A young visitor listens intently as **Lisa Robbins** describes the cold conditions that several USGS scientists will encounter when they embark on a cruise to study ocean acidification in the Arctic Ocean (see "USGS Arctic Ocean Research…," this issue, **http://soundwaves.usgs.gov/2011/08/**).*

At the festival, USGS scientists and staff contributed through a number of activities. Center Director **Kindinger** participated as moderator for an oil-spill panel that included **Steven A. Murawski**, distinguished research professor at the USF-CMS; **David Palandro**, research scientist with the Fish and Wildlife Research Institute; **Bonnie Ponwith**, National Oceanic and Atmospheric Administration (NOAA) Fisheries Service's Southeast Fisheries Science Center Director; and **Jennifer Miselis**, USGS geologist. **Miselis** discussed the role of USGS scientists as representatives on the Operational Science Advisory Team (OSAT) and in oil-spill-related work in response to the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. In addition, USGS oceanographer **Lisa Robbins** and USGS physical scientist **Jamie Cormier**, with support from **Schreppel** and **Burress**, hosted a booth about ocean chemistry. The booth allowed visitors to get an interactive look at pH, ocean acidification, marine calcifiers (organisms such as corals or clams that build their skeletons or shells from calcium carbonate), global food webs, and carbon cycling, and how all of it relates to human activity. Hands-on activities demonstrated the phenomenon and effects of ocean acidification. Children and adults alike enjoyed the hands-on shell-crushing exercise, in which they gained a better understanding of the biological effects of lower-pH conditions in the oceans by comparing the strength of seashells grown in conditions simulating modern seawater with those grown in seawater with a lower pH. They were also able to observe how much carbon dioxide is produced through human respiration (breathing) by exhaling into a CO_2 gas analyzer that showed the amount of CO_2 gas expelled in their breath.

*At the St. Petersburg Science Festival kick-off event, City Councilman **Karl Nurse** emphasizes the importance of science, technology, engineering, and math as economic engines for the community.*

The USGS is proud to be part of a vibrant community that came together to celebrate science in St. Petersburg. The exhibitors and sponsors from the community continue collaborating—inspiring young scientists of the future and fostering interest in science that is vital to society. The festival marked another successful collaboration between the Florida Fish and Wildlife Commission's Fish and Wildlife Research Institute, NOAA's National Marine Fisheries Service, USF-CMS, the Southwest Florida Water Management District, The Pier Aquarium, Draper Laboratory, Eckerd College, USF St. Petersburg, the USGS, the City of St. Petersburg, and Affiliate Partner, The Science Festival Alliance.

More information about the festival can be found at **http://www.stpetescifest.org/**.

The Progressive Baptist Missionary Community Church Drumline and Color Guard excited the crowds with a march through the science festival and along the picturesque Bayboro Harbor waterfront.

Awards

Award for Poster on Web Access to USGS Core Repository

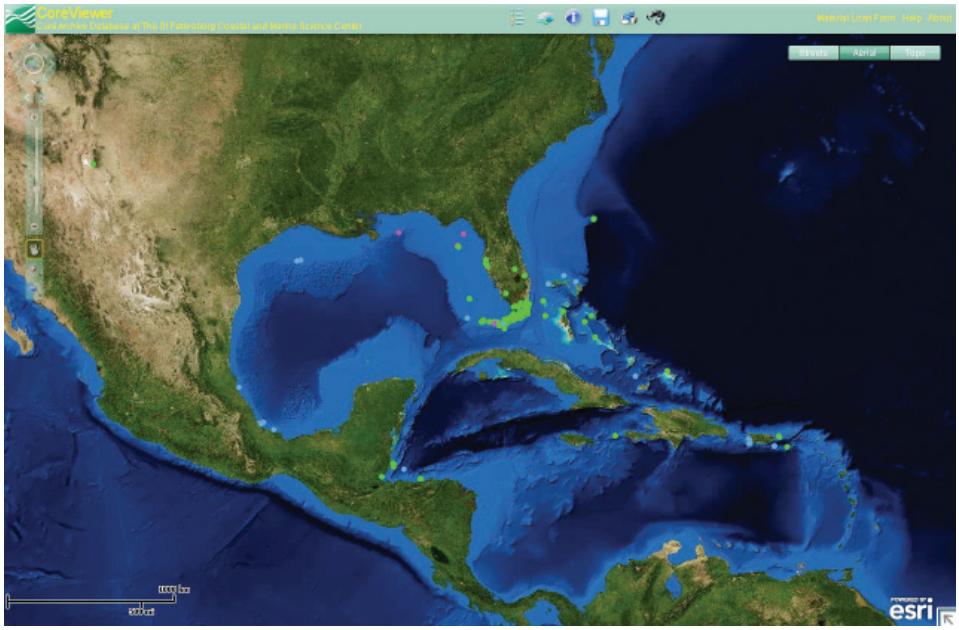
By Matthew Cimitile

A team led by geologist **Chris Reich** of the U.S. Geological Survey (USGS) St. Petersburg Coastal and Marine Science Center in St. Petersburg, Florida, received the poster award for "Best Data or Software Integration" at *The National Map* Users Conference and USGS Geographic Information Science (GIS) Workshop, held May 10-13, 2011, in Golden, Colorado. Their poster describes the St. Petersburg center's Core Archive Portal, a Web site in the final stages of development that will give users access to information about the largest coral core repository in the USGS.

The title of the award-winning poster is "St. Petersburg Coastal and Marine Science Center's Core Archive Portal," and the authors are **Matthew Streubert**, **Brendan Dwyer**, **Chris Reich**, **Meg Godbout**, **Adis Muslic**, and **Daniel Umberger**.

The goal of *The National Map* Users Conference and USGS GIS Workshop was to enhance communication and collaboration among *National Map* users and contributors and to promote advancement of GIS and related technologies within the USGS community. The workshop included both lecture sessions and hands-on sessions that allowed participants to explore new software and databases.

"The conference serves as an awareness of where other centers are in GIS development. You get a taste of the GIS that is happening in the centers nationwide," said **Streubert**, a geospatial analyst/database developer for the USGS in St. Petersburg. "There is always the hope that someone sees what you are doing and applies it to what they are doing, so you develop similar methods, and with similar methods you can work together. If you have people working together on a common code or product that you are using, it is much easier to transfer data between centers and create across-the-board similarities."



Screen shot from the Core Archive Portal, which allows users to search for cores through a world map and zoom in on areas of interest. The portal displays a unique collection of coral and rock cores stored at the USGS St. Petersburg center and collected from areas around the world, including South Florida, Belize, the Philippines, the Gulf of Mexico, and ancient algal reefs in New Mexico.

Learn more about the workshop at **http://nationalmap.gov/uc/**. Videos of workshop presentations are posted at **http://gallery.usgs.gov/video_sets/The_National_Map_Users_Conference/list/_/1**.

Publications

USGS Arctic Study Evaluates Science and Knowledge Gaps for Outer Continental Shelf Energy Development

Offers recommendations to better inform responsible oil and gas decisions for Beaufort and Chukchi Seas

By Leslie Holland-Bartels and Brenda Pierce

In response to a request from Secretary of the Interior **Ken Salazar**, the U.S. Geological Survey (USGS) recently released the "science gap and sufficiency" report evaluating the science needed to better inform decisions regarding oil and natural-gas exploration and development in the Beaufort and Chukchi Seas off Alaska.

In March 2010, **Secretary Salazar** directed the USGS—as part of a comprehensive, science-based approach to energy development on the Outer Continental Shelf—to perform a study to determine what the science gaps were in Outer Continental Shelf energy development in the Arctic, particularly focusing on the Chukchi and Beaufort Seas. The study was released on June 23, 2011.

"There is significant potential for oil and gas development in U.S. Arctic waters, but this is a frontier area with harsh weather conditions as well as unique fish and wildlife resources that Alaska's indigenous people rely on for subsistence," **Salazar** said while announcing release of the report. "To make responsible deci-

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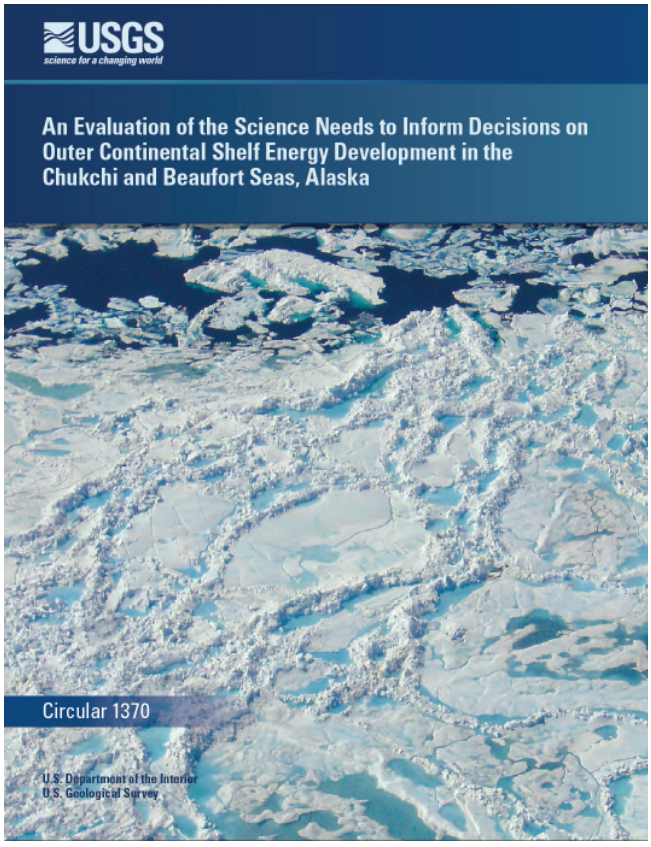
sions, we need to understand the environmental and social consequences of development and plan accordingly. This study is helpful in assessing what we know and will help inform determinations about what we need to know to develop our Arctic energy resources in the right places in the right way."

The report, edited by **Leslie Holland-Bartels** and **Brenda Pierce**, summarizes the large volume of existing scientific information, much of it conducted under the auspices of the Environmental Studies Program of the Bureau of Ocean Energy Management, Regulation and Enforcement; identifies where knowledge gaps exist; and provides initial guidance on new and continuing research that could improve decision making. More than 50 findings and an equal number of recommendations are contained in the 279-page report, titled *An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska*. Chapter and appendix authors, in addition to **Holland-Bartels** and **Pierce**, are (in order of appearance of their contributions): **Jonathan J. Kolak**, **Anthony R. DeGange**, **Lyman Thorsteinson**, **Gary D. Clow**, **Dirk V. Derksen**, **Christian E. Zimmerman**, **Deborah R. Hutchinson**, **Richard C. Ferrero**, **Sarah J. Converse**, and **Dede Bohn**.

*Classified as endangered under the Endangered Species Act, bowhead whales summer in the Canadian Beaufort Sea, migrate through the U.S. Beaufort Sea into the Chukchi Sea, and winter in the northern Bering Sea. Bowhead whales are an important subsistence species and are hunted in the spring and autumn as they pass coastal Alaskan villages in the northern Bering, Chukchi, and Beaufort Seas. Noise, oil pollution, and climate change are important concerns. Photograph courtesy of the National Oceanic and Atmospheric Administration (NOAA; **http://www.photolib.noaa.gov/htmls/anim0842.htm**).*



Cover of the new report. Photograph depicts first-year summer sea ice with melt ponds typically found in the Chukchi Sea, Alaska; taken 100 nautical miles offshore west of Barrow, Alaska, July 8, 2010.

"I want to applaud the USGS team for the very thorough and inclusive way in which they conducted this study of the Arctic," said USGS Director **Marcia McNutt**. "They examined more than 400 scientific publications, workshop findings, and science policy documents; met with more than 40 individuals and organizations that have research or science assessments on these areas; and held a series of discussions with key stakeholders, including North Slope and Native Alaskan interests, the oil industry, federal agencies, the State of Alaska, and nongovernmental organizations." Their work demonstrates that extensive scientific information already exists in this area and is proliferating rapidly, **McNutt** said. "This USGS study provides a significant review of the science available in order to clarify its scope and help us understand what else we need to know and how to get there."

Among the major areas noted in the report where additional scientific research, analysis, and synthesis could reduce uncertainties are the following:

- Developing a better understanding of the effects of climate change on physical, biological, and social conditions as well as resource-management strategies in the Arctic;
- Developing foundational geospatial data on the Arctic Outer Continental Shelf;
- Synthesizing existing scientific information on a wide range of topics on the Arctic;
- Building upon advances in spill-risk evaluation and response knowledge by developing better information on key inputs to spill models (such as oceanographic, weather, and ecological data);
- Improving dialogue and using collaborative, comprehensive science planning, both domestically and internationally.

A fact sheet on the Arctic study is available at **http://pubs.usgs.gov/fs/2011/3048/**.

The full report is available at **http://pubs.usgs.gov/circ/1370/**.

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Sound Waves
U.S. Geological Survey
345 Middlefield Road, MS 999
Menlo Park, CA 94025